Revue suisse Zool.	Tome 86	Fasc. 3	p. 611-623	Genève, septembre 1979

Observations on Clambidae (Coleoptera), with descriptions of a new genus and species and of several larvae

by

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ABSTRACT

The family Clambidae is redefined, taking account of the characters of the larvae of *Clambus* Fisch., *Calyptomerus* Redt. and *Acalyptomerus* gen. nov.; 3 subfamilies are distinguished, one of them based on the new genus and species *Acalyptomerus asiaticus*. A key with figures is provided to separate 3 genera as larvae. Further evidence is adduced for the inclusion of the family in Eucinetoidea.

INTRODUCTION

The small family Clambidae has until recently been associated by nearly all systematists with Liodidae etc. in Staphylinoidea, and this view has been maintained by the most recent specialist in the group, S. ENDRÖDY-YOUNGA (1959 etc.). Non-Staphylinoid characters of the wing venation and folding were pointed out by FORBES (1926), and long ago the present writer (CROWSON 1938) noted the similarity of the *Clambus* metendosternite to those of Helodidae and its great difference from known Staphylinoid types. Larvae of *Clambus* and *Calyptomerus* were reared by CROWSON & CROWSON (1955) and found to be more akin to those of *Eucinetus* than of any known Staphylinoidea. A similar relationship was deduced by HLAVAC (1975) from prothoracic structures. The conclusion of CROWSON (1960), associating Clambidae with Eucinetidae and Helodidae in a superfamily Eucinetoidea, appears to be consistent with all the evidence so far available.

DEFINITION

The inclusion of the genus *Acalyptomerus* (see below) requires some modification of previously accepted definitions of the family (e.g. by ENDRÖDY-YOUNGA, *loc. cit.*), and it is now possible to formulate for the first time an adequate definition by larval characters.

ADULT Clambidae can normally be recognised by the combination of excavate hind coxae, 8-10 segmented antennae with a 2-segmented club, 4- or 3-segmented filiform tarsi, prosternal process not received in mesosternum, metasternum without a transverse suture, aedeagus of trilobe type with distinct basal piece, wing-venation and folding of characteristic types (Forbes 1926), met-endosternite of Helodid type (Crowson 1938), abdomen with functional spiracles on segments 1-5 and sometimes 8, elytra completely covering abdomen, never with striae.

LARVAE of Clambidae are cylindrical to fusiform in shape, without urogomphi and with the head plagiognathous. The head capsule is open ventrally, with clypeus and labrum distinct, frontal sutures usually indistinct, coronal suture very short or absent; there may be 1-5 ocelli on each side. Antennae 3-segmented, with the sensory appendage of segment 2 ventral to segment 3. Mandibles with well developed molar part bearing rows of asperities, prostheca (figs. 2, 18, 24) represented by a more or less articulated and sclerotised tooth close to apex of cutting edge. Maxillae with well-developed cardo and articulating area, palpi 2-3 segmented, galea not fimbriate, not clearly articulated, distinct and slender (fig. 20) or more or less fused to lacinia (figs. 3, 25). Labium with broadly rounded ligula and widely separated 1-2 segmented palpi. Legs rather long, coxae narrowly separated and projecting, claws elongate with 2 setae. Spiracles annular. Abdomen with segment 9 narrower than 8, 10 forming a pygopod which does not bear apical hooks.

KEY TO SUBFAMILIES AND GENERA

1. Eyes partly or wholly divided by a canthus. Front coxal cavities open behind. Abdomen with functional spiracles on segment 8. Parameres of male more or less fused . . . . CLAMBINAE — 2

— Eyes not at all divided. Front coxal cavities closed behind. Abdomen without functional spiracles on segment 8. Parameres usually separated . . . . . . — 4

2. Antennae 8-segmented. 6 visible abdominal sternites. Apices of middle coxae not nearly touching. Mandibles with rounded blunt apices. Eyes not completely divided. Palaearctic species . . . . 3. *Loricaster* Muls.

— Antennae 10-segmented. 5 visible abdominal sternites. Apices of middle coxae almost or quite touching each other. Mandibles with acute apices 3

3. Eyes not completely divided. 8th abdominal spiracles prolonged into horn-like processes. Antennal segment 3 little longer than 4. Australian and New Zealand species . . . . 1. *Sphaerothorax* Endr. — Y.

— Eyes completely divided into dorsal and ventral parts. 8th abdominal spiracles not projecting. Antennal segment 3 much longer than 4. Cosmopolitan . . . . 2. *Clambus* Fisch.

4. Head not at all flattened, much narrower than prothorax (fig. 6), eyes protuberant. Prothorax trapezoidal, much narrowed in front (fig. 11). Tarsi 3-segmented, antennae 9-segmented. Abdomen with 5 visible sternites. Parameres partly fused. Mandibles characteristic (fig. 8). Cosmopolitan in warmer climates: ACALYPTOMERINAE . . . . 4. *Acalyptomerus* gen. nov.

— Head strongly flattened, as wide as prothorax, eyes not projecting. Prothorax almost semicircular, widest in front. Tarsi 4-segmented, antennae 10-segmented. Abdomen with 6 visible sternites. Parameres quite separate. Mandibles not channelled. Holarctic: CALYPTOMERINAE . . . 5. *Calyptomerus* Redt.

KEY TO GENERA OF CLAMBID LARVAE

1. Antennal segment 3 much longer than sensory appendage of 2 (fig. 1). Mandibles without ventral crushing tubercle, molar asperities in regular transverse rows (fig. 2). Ocelli absent or represented by a weak pigment spot. Setae of head as figured (fig. 1), not arising from distinct tubercles. Spiracles of abdominal segment 8 vestigial (fig. 5) . . . . *Clambus* Fisch.

— Antennal segment 3 shorter than sensory appendage of 2 (figs. 19, 23). Mandibles with ventral crushing tubercle (figs. 18, 24). Setae of head arising from marked tubercles (fig. 23). Spiracles of abdominal segment 8 normal 2

2. 5 ocelli on each side. Mandibles with asperities of mola irregularly arranged (fig. 24). Maxillae with normal 3 segmented palpie, galea not distinct (fig. 25). Prothorax not expanded laterally. Leg (fig. 27) with claw less than half as long as tibia . . . . *Calyptomerus* Redtb.

— 1 ocellus on each side. Mandibles with molar asperities in transverse rows (fig. 18). Maxillae with very short 2-segmented palp and distinct slender galea (fig. 20). Claw at least half as long as tibia (fig. 22) . . . *Acalyptomerus* gen. nov.

1. **Sphaerothorax** Endrödy-Younga. Type *S. maori* Endr.-Y.

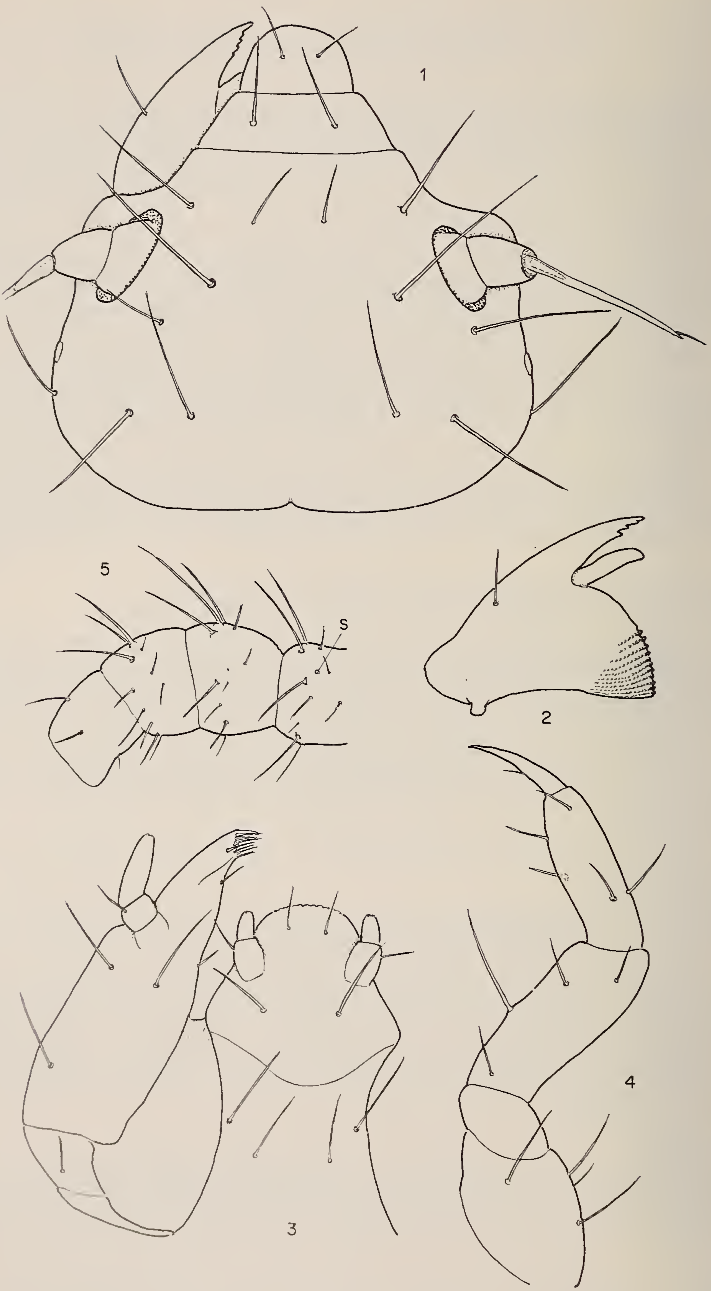
In addition to the characters cited in the above key and by Endrödy-Younga (1959), this genus differs from *Clambus* in wing-venation, met-endosternite and details of the maxillae. The development of the last pair of spiracles is hardly to be paralleled elsewhere in Coleoptera. The internal genitalia of the female indicate that the eggs are relatively smaller and more numerous than those of *Clambus nigriclavis*. I have studied a single female collected by me in leaf-litter from Botanic Hill, Nelson, New Zealand on 17 Feb. 1957.

2. **Clambus** Fischer

Larvae of *C. nigriclavis* Steph. were reared by Crowson & Crowson (1955) from field-collected adults in spring; adults were placed in petri dishes with small pieces of stick previously soaked in a nutrient broth and sterilised; relatively large eggs were deposited singly on the sticks, at a rate of not more than 1 per female per day. Eggs hatched in about a week at room temperatures and the larvae fed on small fungal growths which had developed on the sticks. The following description is based on larvae so obtained and on very similar ones collected in leaf-litter in the field in association with adults of *C. armadillo*.

GENERAL FORM elongate and only slightly fusiform, head and thoracic segments of nearly equal width, abdomen gradually tapered to apex. General colour whitish, cuticle smooth and shining, dorsum rather sparsely clothed with long projecting setae.

HEAD transversely ovate (fig. 1), without evident frontal sutures, clypeus distinct, labrum nearly semicircular, dorsal setae as figured, not arising from tubercles, a lateral pigment spot sometimes present. Antennal segment 3 elongate and much longer than sensory appendage. Mandibles (fig. 2) symmetrical, prostheca represented by an articulated sclerotised pre-apical tooth, mola with transverse rows of asperities, no ventral



FIGS. 1-5.

Clambus nigriclavis larva.

1: head capsule, dorsal view. — 2: R mandible, ventral view. — 3: R maxilla and labium, ventral view. — 4: R front leg, posterior view. — 5: terminal abdominal segments, lateral view. S: spiracle of abdominal segment 7.

crushing tubercle. Maxillae (fig. 3) with mala not clearly divided, palpi short, stipes dorsally with a small number of rather strong denticles just before the level of the palp insertion. Labium (fig. 3) with broad obtuse ligula, palpi 2-segmented.

THORAX with the 3 segments nearly equal in size and shape, each more than twice as wide as long. Dorsum with paired tergal sclerites visible in some specimens, smooth except for few long setae. Legs with chaetotaxy as figured (fig. 4), claws with 1 large ventral seta and a smaller posterior one. Thoracic spiracle situated laterally, on front part of mesothorax.

ABDOMEN tapering in its apical part, segment 8 about half as wide as 1, terga smooth and shining, slightly shorter than thoracic ones, with long setae not arising from distinct tubercles. Segment 9 small, 10 forming a short posteroventral pygopod. Spiracles lateral, those of segment 8 minute and probably non-functional. Chaetotaxy of terminal segments as figured (fig. 5).

It was found by CROWSON & CROWSON (1955) that females of *C. nigriclavis* produced very large eggs, deposited on damp sticks, not more than 1 per day, and that larval development was relatively rapid.

3. **Loricaster** Muls. & Rey

I have studied a female of *L. testaceus* Muls. & Rey, collected by me in leaf-litter from La Massane, near Argelès-sur-Mer, France on July 10, 1959. In some features, particularly of head structure, this insect tends to resemble *Sphaerothorax* rather than *Clambus*. Nothing appears to be known of its earlier stages.

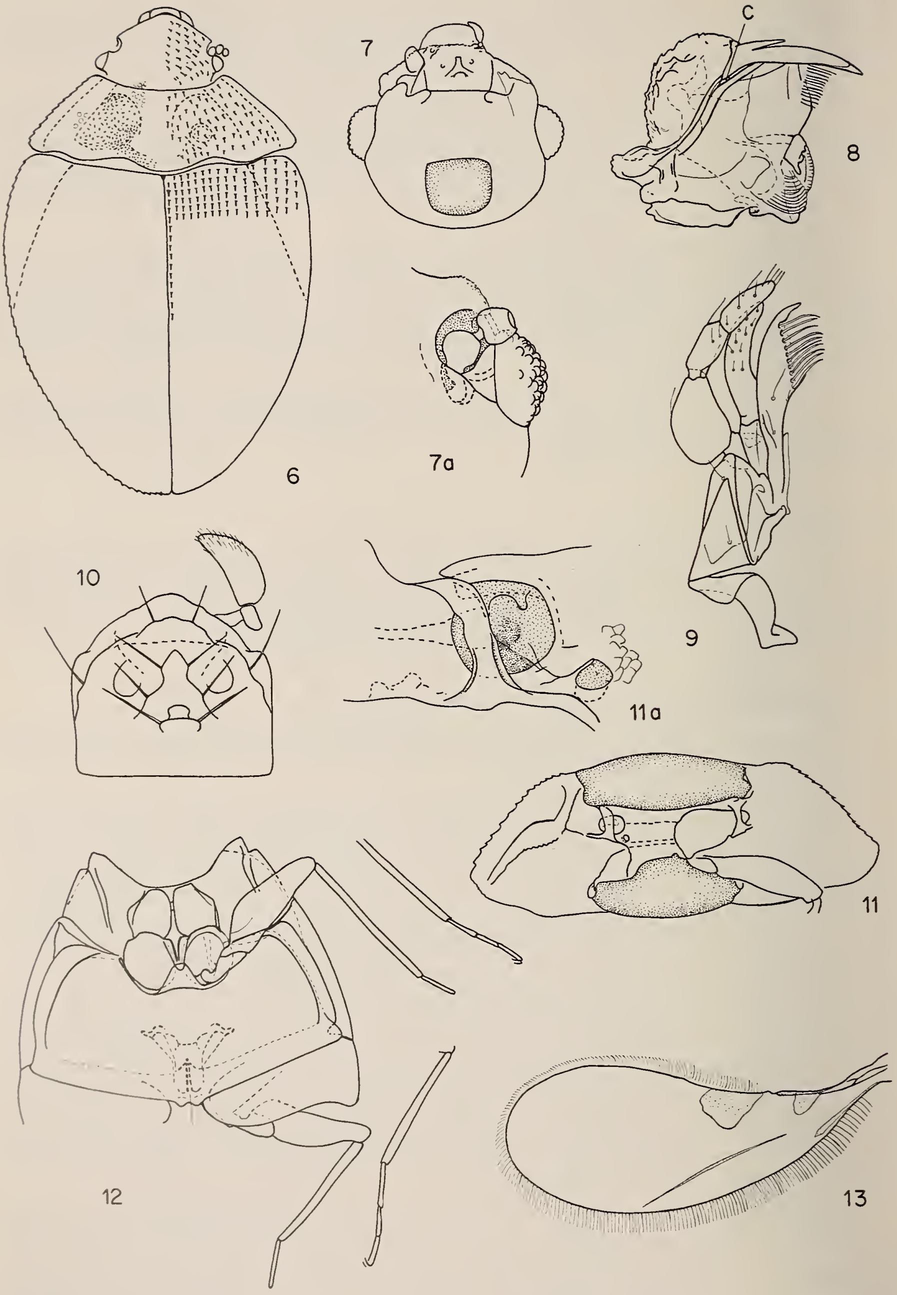
4. **Acalyptomerus** gen. nov. Type *A. asiaticus* sp. nov.

With general features of Polyphaga, Eucinetoidea and Clambidae. Species small, of ovate dorsally convex form (fig. 6).

HEAD moderate sized, much narrower than prothorax, general outline rounded with small protuberant coarsely facetted eyes (fig. 7); front-clypeal suture distinct, nearly straight; labrum transverse with evenly rounded front margin; antennal insertions moderately close to eyes, partly covered by sides of frons (fig. 7*a*), sharply bordered grooves along anteroventral margins of eyes receiving basal segments of reflexed antennae; gula markedly convex. Antennae 9-segmented, segments 1 and 2 short ovate and similar in size, 3-7 much narrower and elongate, 8 and 9 widened to form a club. Mandibles (fig. 8) with a deep longitudinal groove or channel extending from just below the apical tooth to just above the ventral condyle, mola with transverse ridges, prostheca broad, membraneous, fringed, with a strong sclerotised tooth apically on the left mandible only. Maxillae with galea rather slender without apical brush (fig. 9), lacinia with stout apical tooth, palpi with segment 1 small, 2 large and inflated, 3-4 narrower and subequal. Labium as figured (fig. 10), palpi 2-segmented, segment 1 slender and twisted, ligula very broad, obtuse and sclerotised.

PROTHORAX, seen dorsally, transverse and very contracted in front; in ventral view, the main part of the segment is seen to be relatively narrow and almost cylindrical, with large thin lateral expansions of the notum (fig. 11); hypomera with inner parts strongly concave, separated from flat outer part by a ridge; prosternum without an inter-coxal keel; coxal cavities transverse, closed behind (fig. 11*a*).

MESOTHORAX with pleural and sterno-pleural sutures distinct, sternum with median longitudinal keel, middle coxal cavities narrowly separated (fig. 12); scutellum

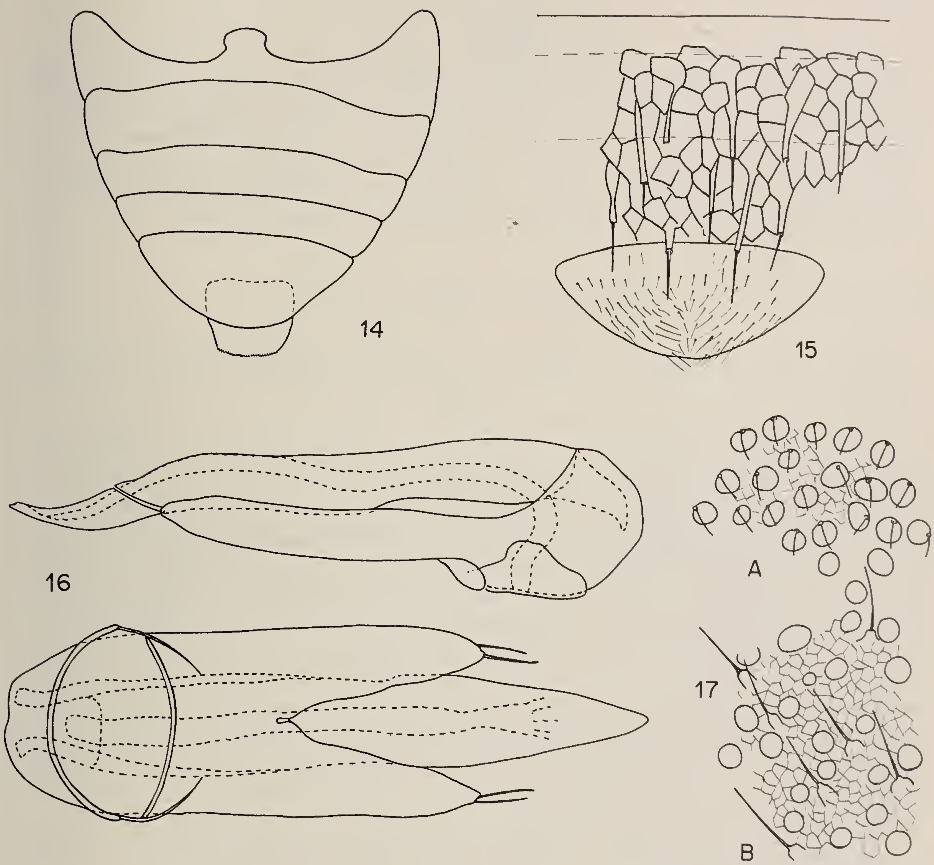


FIGS. 6-13.

Acalyptomerus asiaticus, adult.

6: whole insect, dorsal view. — 7: head capsule, ventral view; 7*a*, detail of antennal insertion, dorsal view. — 8: R mandible, ventral view. C — suctorial channel. — 9: R maxilla, ventral view. — 10: labium, ventral view, R palp removed. — 11: prothorax, ventral view, R leg removed; 11*a*, detail of coxal cavity. — 12: pterothorax, ventral view, R middle leg removed, metendosternite shown by broken line. — 13: wing venation.

usually covered by hind margin of pronotum. Elytra not at all truncate apically, evenly rounded at sides, epipleura very broad in humeral region, rapidly narrowing to disappear at the middle (fig. 1), dorsal surface with regular rows of short pubescence, no indication of a scutellary striole, outer margin finely serrate.



Figs. 14-17.

Acalyptomerus asiaticus, adult.

14: abdominal sternites, ventral view. — 15: terminal abdominal tergites, dorsal view. — 16: aedeagus, ventral and lateral views. — 17: surface sculpture of vertex (A) and pronotum (B).

METATHORAX (fig. 12) with sternum strongly convex and transverse, no distinct sternal sutures, its side margins curved and converging anteriorly, episternum with inner front angles produced and almost reaching middle coxal cavities, sternum with relatively broad anterior process meeting mesosternum between coxae; metendosternite as figured (fig. 12); hind coxae extending laterally to meet epipleura, their front margins straight, hind margins extended to form moderately broad femoral plates, somewhat sinuate, broadest at outer ends.

LEGS with trochanters somewhat elongate, femora moderately slender, thickest in basal half, tibiae slender, without spines other than apical spurs, not carinate, with 2 small normal spurs; tarsi slender, 3-segmented, segment 1 longest, 2 shortest; claws small, simple, empodium not distinct.

WINGS with venation as figured (fig. 13), resembling *Clambus* rather than *Calyptomerus.*

ABDOMEN with 5 visible sternites, moderately convex transversely, the first 4 nearly equal in median length, 5th considerably longer than them; tergites 1-6 soft, 7-9 sclerotised, without distinct paratergites; spiracles situated in lateral membranes of segments 1-5; paraprocts meeting in front of proctiger, fused in ♀, separated by suture in ♀; sternite of segment 9 not distinct; aedeagus with main part of tegmen dorsal to median lobe, parameres basally fused to each other and partially to basal piece (fig. 16); ovipositor very reduced, with valvifers but no distinct coxites or styli.

Acalyptomerus asiaticus sp. nov.

General colour brownish, surface dull, coarsely sculptured and with recumbent pubescence.

Upper surface of head uniformly closely sculptured (fig. 17*A*) with large round punctures, larger than individual ommatidia, each with a small seta arising from a tubercle on its hind border and projecting forward. A row through the centre of each eye composed of about 10 very convex ommatidial lenses. Pronotum with uneven surface, a central longitudinal raised portion flanked by large paramedian transverse impressions, front margin raised in central part, a transverse raised area with a small median impression just before hind margin, a distinct longitudinal raised ridge separating central area from lateral parts; puncturation (fig. 17*B*) resembling that of vertex except that the small setae arise from lateral parts of large punctures and project backward, flanks of pronotum with punctures merging into a network-like reticulation; side margins slightly explanate and finely serrated. Each elytron with about 16 nearly regular rows of short backward projecting spine-like setae, arising from centres of star-like patterns of rugosities; costal margin with about 40 crenulations between the humeral and sutural angles. Aedeagus as figured (fig. 16). Length of holotype 1.23 mm, maximum width of prothorax 65 mm. Length range in type series 1.17-1.30 mm.

Holotype: Gampaha, W. Ceylon, 5.12.72, coll. Mussard, Besuchet and Löbl, ♂ with dissected aedeagus.

Paratypes: 33 specimens with same data as holotype.

All type material in collection of Muséum d'Histoire naturelle, Ville de Genève, Switzerland.

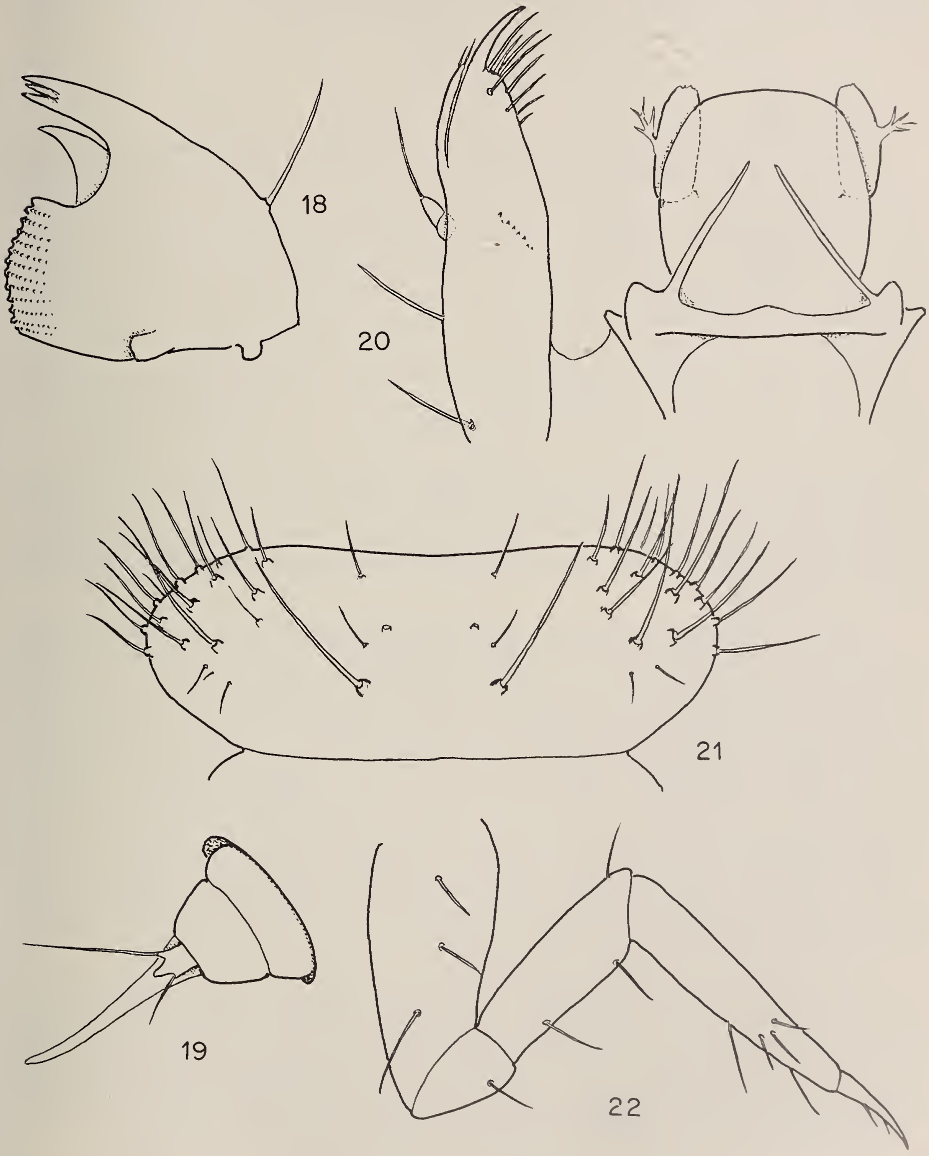
Larval characters of *Acalyptomerus.*

General form somewhat fusiform, head considerably narrower than the rather broad prothorax, abdominal segments tapering to the apex.

Head dorsally with setae arising from pronounced tubercles. 1 ocellus on each side. Antennae (fig. 19) with segment 3 small, sensory appendage of segment 2 very long. Mandibles with 3-toothed apex, prostheca rather broad and membranous, mola with transverse rows of asperities (fig. 18), ventral crushing tubercle well developed. Maxillae (fig. 20) with very short 2-segmented palpi, galea distinct, elongate and slender.

Labium with 1-segmented palpi, the palp with a semi-membranous branched appendage on its outer side (fig. 20).

Prothorax slightly longer than following segments, with expanded notum bearing seatae on tubercles as figured (fig. 21). Legs (fig. 22) with bisetose claw. 8 pairs of small annuliform laterally situated abdominal spiracles. Meso- and metanota with sclerotised lateral expansions bearing setiferous tubercles. Pygopod small, short.



Figs. 18-22.

Acalyptomerus asiaticus larva.

18: L mandible, ventral view. — 19: R antenna, dorsal view. — 20: apical part of L maxilla, and labium, dorsal view. — 21: pronotum. — 22: R hind leg, anterior view.

I have seen specimens apparently indistinguishable from *A. asiaticus* from Japan, Perak, Australia, India, Ceylon, Kenya, Mauritius, South Africa and Central America. The species occurs commonly in hay stacks and similar accumulations of decaying vegetation, and probably owes its wide distribution to human agency, being transported in fodder or bedding material for horses, cattle, etc. The specific name embodies the hypothesis that its original homeland was somewhere in Asia. The oldest specimen I have seen in a collection was collected by G. Lewis in Japan in the 1880's.

5. **Calyptomerus** Redt. Larva studied: *C. dubius* Marsh.

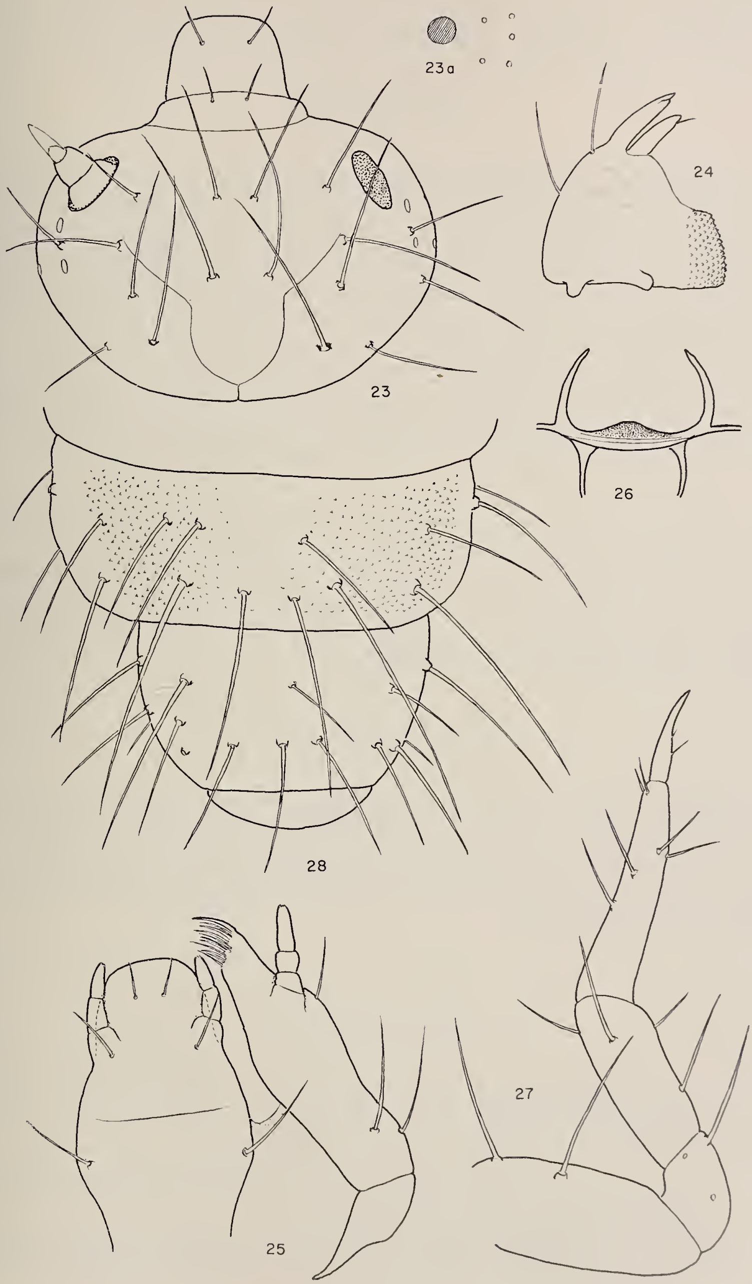
The first author to study the young stages of *Calyptomerus* seems to have been Perris (1852), under the name of *Clambus enshamensis*; his figures of the larva and pupa are quite inadequate for modern systematic purposes, but his account of the habits and life-cycle is still useful. Rymer Roberts (1930) included *Calyptomerus* in his key to larvae of Coleoptera, without figures or a separate description; the characters indicated in his key are all, except for the alleged lack of a mandibular mola, more or less applicable to the larva described below; it seems likely that he had the true larva, but described the mandible from a damaged preparation. *C. dubius* was later reared by Crowson & Crowson (1955), whose account of its biology agreed in essentials with that of Perris *(loc. cit.)*. The description below is based on larvae reared from eggs by Crowson & Crowson, and on similar ones collected in wild habitats with adults of *C. dubius*.

GENERAL SHAPE elongate-fusiform, broadest at metathorax, head considerably narrower than prothorax, abdominal segment 9 less than half as wide as 1. Trunk with vestiture of long projecting setae, mainly curved backwards towards apex. General colour greyish-white, with some ochreous pigmentation of head capsule and pronotal sclerites.

HEAD transverse-ovate, clypeus short, much narrower than front margin of frons, labrum quadrate with rounded front margin (fig. 23). 5 ocelli on each side, arranged as in fig. 23*a*. Dorsal chaetotaxy as figured (fig. 23), the main setae arising from strong tubercles, general surface between the tubercles set with rather irregular asperities, dull. Antennae with segments 1 and 2 short and strongly transverse, 3 quadrate, much narrower than 2, sensory appendage elongate-conical, about twice as long as segment 3 (fig. 23). Mandibles (fig. 24) symmetrical, prostheca forming a sclerotised articulated tooth behind the apical one, mola with asperities not arranged in transverse rows, ventral crushing tubercle distinct, outer face with 2 long setae. Maxillae (fig. 25) with division of mala indicated only by a groove, apex of mala with 6 large curved spines, middle of stipes dorsally with an irregular group of sharp denticles. Labial palpi 2-segmented, elongate; hypopharyngeal sclerome as figured (fig. 25).

THORAX with prothorax almost semicircular in outline, meso- and metathorax strongly transverse. Pronotum with 2 pigmented sclerites separated by a median pale line, each sclerite with about 15 tubercles bearing long setae, surface between them evenly spread with small asperities; meso- and metanota with less distinctly pigmented paired sclerites bearing similar vestiture. Legs with chaetotaxy as figured (fig. 27). Thoracic spiracle situated latero-ventrally on front part of mesothorax.

ABDOMEN tapering to apex, tergites 1-8 with more or less distinct unpaired sclerotisations bearing setiferous tubercles and asperities like those of thorax. Segment 9 almost semicircular in outline, with setiferous tubercles and asperities dorsally as on previous segments, segment 10 forming a short ventral cylindrical pygopod (fig. 28).



FIGS. 23-28.

Calyptomerus dubius larva.

23: head capsule, dorsal view; 23a, arrangement of ocelli L side. — 24: R mandible, ventral view. — 25: L maxilla and labium, ventral view. — 26: hypopharyngeal sclerome, dorsal view. — 27: L middle leg, anterior view. — 28: abdominal segments 8-10, dorsal view.

The larvae feed on moulds; Crowson & Crowson (1955) were able to rear them on mould cultures in petri dishes. Pupae exposed and partly enclosed in last larval skin.

DISCUSSION

The basic features of Clambidae must now be taken to include a divided larval maxillary mala as in *Acalyptomerus* (and in *Eucinetus*), which greatly strengthens an already strong case for placing the family in Eucinetoidea. An ancestral Clambid would probably have had 10-segmented antennae with a 2-segmented club, more or less entire eyes as in Calyptomerinae, front coxal cavities open behind as in Clambinae, 4-segmented tarsi, mesothorax with all sclerites distinct as in *Acalyptomerus*, abdomen with 5 visible sternites as in *Clambus* and *Acalyptomerus*, wings probably as in *Sphaerothorax*, functional spiracles on abdominal segment 8 as in *Clambus*, aedeagus with fully separate parameres as in *Calyptomerus*; the larva would have had a divided maxillary mala as in *Acalyptomerus*, 5 ocelli on each side as in *Calyptomerus*, mandibles with a ventral crushing tubercle as in *Calyptomerus*, abdominal segment 8 with functional spiracles as in Calyptomerinae.

It is noteworthy that abdominal segment 8 has functional spiracles in adults but not larvae of *Clambus*, whereas the reverse relation applies in Calyptomerinae. In *Eucinetus* both adults and larvae have normal 8th abdominal spiracles; Helodidae lack these spiracles in the adults while in their larvae they are the only functional pair. It appears that there may be some interaction between the genetic determinants of the development of this spiracle in the two stages.

ACKNOWLEDGEMENTS

I am indebted to Dr. Ivan Löbl of the Natural History Museum of the city of Geneva for the loan of the type material of *Acalyptomerus asiaticus*, and for the line drawings of adult structure of that species. The study was carried out in the Zoology department of Glasgow University, using materials partly drawn from the insect collection of the Hunterian Museum.

BIBLIOGRAPHY

Crowson, R. A. 1938. The metendosternite in Coleoptera; a comparative study. *Trans. R. ent. Soc. Lond.* 87: 397-416.

— 1960. The Phylogeny of Coleoptera. *A. Rev. Ent.* 5: 113-134.

Crowson, R. A. and E. A. Crowson. 1955. Some observations on Beetles of the Family Clambidae. *Glasg. Nat.* 17 (4): 205-206.

Endrödy-Younga, S. 1959. Systematische Überblick über die Familie Clambidae. *Opusc. ent.* 24: 81-116.

Forbes, W. T. M. 1926. The wing-folding patterns of Coleoptera. *Jl. N. Y. ent. Soc.* 34: 42-68, 91-139.

Hlavac, T. 1975. The Prothorax of Coleoptera (except Bostrichiformia-Cucujiformia). *Bull. Mus. comp. Zool. Harv.* 147: 137-183.

Perris, R. 1852. Histoire des metamorphoses du *Clambus enshamensis*. *Annls. Soc. ent. Fr.* (2) 10: 574-578, pl. XIV.

Roberts, A. W. Rymer. 1930. A Key to the Principal Families of Coleoptera in the Larval Stage. *Bull. ent. Res.* 21: 57-72.

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